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# Merger Failures

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ABSTRACT

**Merger Failures***

by Albert Banal-Estañol and Jo Seldeslachts

This paper proposes an explanation as to why some mergers fail, based on the interaction between the pre-merger gathering of information and the post-merger integration processes. Rational managers acting in the interest of shareholders may still lead their firms into unsuccessfully integrated companies. Firms may agree to merge and may abstain from putting forth integration efforts, counting on the partners to adapt. We explain why mergers among partners with closer corporate cultures can have a lower success rate and why failures should be more frequent during economic booms, consistent with the empirical evidence. Our setup is a global game (integration process) in which players decide whether to participate (merger decision). We show that private signals need to be noisy enough in order to ensure equilibrium uniqueness.

*Keywords: mergers, synergies, information, uncertainty, organizational culture.*

*JEL Classification: D74, D82, L20, M14*

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ZUSAMMENFASSUNG

## Gescheiterte Fusionen

In dieser Arbeit wird eine Erklärung vorgestellt für das Scheitern von Fusionen. Sie beruht auf einem Modell, das das Verhalten der fusionierenden Firmen vor der Fusion, wenn Erkundungen über den Partner eingeholt werden, und nach der Fusion, wenn sich die Unternehmensteile integrieren müssen, in den Mittelpunkt stellt. Manager können nach diesem Modell durch rationales Verhalten die fusionierte Firma in Verluste und schlechte Aktienwerte führen, obwohl sie eigentlich das Interesse der Aktionäre im Blick haben. Die Firmen stimmen einer Fusion zu, halten sich aber beim Voranbringen der Integrationsbemühungen zurück, da sie darauf zählen, dass sich die Partner anpassen. Wir erklären, warum Fusionen zwischen Partnern mit ähnlichen Unternehmenskulturen eine geringere Erfolgsrate haben können und warum Misserfolge häufiger während eines wirtschaftlichen Booms auftreten. Dies ist konsistent mit empirischen Ergebnissen. Unser Ausgangspunkt ist ein globales Spiel, in dem der Integrationsprozess dargestellt wird und die Spieler entscheiden, ob sie sich am Spiel beteiligen, d.h. der Fusion zustimmen. Wir zeigen, dass ein eindeutiges Gleichgewicht nur garantiert werden kann, wenn die privaten Informationen der fusionierenden Firmen, die dem Fusionspartner nicht bekannt sind, genügend unpräzise sind.

# 1 Introduction

A large number of mergers and acquisitions are unsuccessful. Over the last fifteen years, 43% of all merged firms worldwide reported lower profits than comparable non-merged firms (Gugler et al. [13]).[1] DaimlerChrysler, the outcome of the largest industrial merger ever, for example, has only posted low or negative profits since its birth in 1998 – including the biggest loss in German business history in 2001.[2] The disappointing results of mergers have been puzzling commentators and academics alike.

In the management literature, poor merger performance has often been connected to unsuccessful integration of different corporate cultures.[3] Cultural differences, however, are not enough to explain failures. First, firms seem to be aware of organisational difficulties when taking merger decisions. DaimlerChrysler, for example, anticipated post-merger challenges.[4] Second, mergers between partners with closer corporate cultures sometimes perform worse (Morosini et al. [22]). Cultural affinity does not prevent mergers from failing.

This paper proposes an explanation as to why some mergers fail while others succeed. We build a theory that investigates the interaction between the pre-merger and the post-merger processes. In the pre-merger period, firms collect information about the potential synergy gains. If they then agree to merge, each firm decides to which extent it exerts

[1] Likewise, Ravenscraft and Scherer [25] find that operating income as a percentage of assets is considerably lower for the merged businesses. Agrawal et al. [1] report that NYSE aquiring firms suffer a statistically significant loss over the 5-year post-merger period. Porter [24] reveals in a longitudinal study that 50% of merged firms divested later on.

[2] By mid 2004, the firm's market value had fallen to less than half of the pre-merger combined value, while rivals improved in the same period (The Economist, 09/02/2004). "DaimlerChrysler's results are totally unacceptable. Their CEO is the only one in the industry who's still arguing that the merger was a smart move." (Business Week, 02/2004).

[3] See Larsson and Finkelstein [19] for a recent survey.

[4] The DaimlerChrysler Merger Statement (1998) reports: "Although the management of Chrysler and Daimler-Benz expects the merger will produce substantial synergies, the integration of two large companies, incorporated in different countries and with different business cultures, presents significant challenges".

an integration effort in the post-merger period. A more integrated company leads to a higher realisation of the potential synergy gains.

We show that managers, although being rational and acting in the interest of their shareholders, can lead their firms into an unsuccessfully integrated entity. At the same time, we uncover some of the dangers of mergers among partners with close corporate cultures. Furthermore, according to our explanation, failures should be more frequent during economic booms, which is consistent with the empirical evidence (Harford [14] and Gugler et al. [12]).

Our theory builds on three ingredients. First, firms posses some private information about the potential synergy gains when making merger decisions. Indeed, the reaction of the competitors, the economic fundamentals or the unknown strategic fit of the partners make these gains, and therefore merger profitability, uncertain. Before merging, however, prospective partners collect information. Although part of this information is shared, another part remains private. Potential partners do not want to give out all their information. If the merger does not materialise, for example, a firm could use this information against the other when competing.[5]

Second, synergy realisation, and therefore merger performance, hinges upon the exertion of costly integration efforts. At the time of merging, firms have distinct cultures, but can move towards a common corporate culture during the post-merger integration process.[6] These organisational adjustments are costly. Managers and employees may prefer to maintain the old way of doing things – because of learning costs, inertia, etc.– and resist adopting some of the partners' practices (Carrillo and Gromb [9], and Hermalin [16]). The degree of organisational integration determines the extent of synergy realisa-

[5]Full information disclosure may also violate competition laws. The Federal Trade Commission articulated that the exchange of sensitive information prior to the clearance of the merger may amount to a breach of the United States competition legislation. Several successful legal actions have been brought in on this basis (see for example *FTC Watch No. 265, at 3; 232-233*, and the Case *United States v. Input/Output, Inc. and Laitram Corp., 1999 WL 1425404, at *1*).

[6]A common corporate culture is defined as holding similar assumptions and views among organisational members, facilitating communication and action (Kreps [18])

tion (Larsson and Finkelstein [19]).[7] In particular, we assume that if the differences have not been reduced at all by the end of the post-merger process, the opportunity costs of merging will not be compensated for.

And third, post-merger efforts show strategic uncertainty. In many circumstances it is intrinsically hard to describe the desired actions in sufficient detail to distinguish them from seemingly similar actions with very different consequences (Mailath et al. [20]). We thus argue that integration efforts are neither ex ante nor ex post contractible. Further, managers will not change behaviour after observing some of the partner's actions and integration decisions are modelled as simultaneous.[8] We concentrate on the case where the more one adapts, the more beneficial it becomes for the partner to adapt. As recognised in the management literature, this describes best a post-merger relationship. Stahl et al. [29] for example argue that, in any type of merger and acquisition, all partners need to exert effort to win the trust of the others and to foster integration efforts. In our model, this is equivalent to efforts being strategic complements, i.e. a merging partner has more incentives to integrate when it assigns a higher probability that the other partners will integrate.

We find a unique equilibrium and show that it may be optimal for a firm to agree on merging and to abstain from exerting any integration effort. The equilibrium decision predicts that for intermediate expected synergies, a firm may merge and expect its partner to do the necessary integration efforts. If expectations were high, a firm would always

[7] If the units continue to differ too much in their conventions, conflict and misunderstanding may prevent the merged firm from realising its economic efficiency. The DaimlerChrysler Statement (1998) explicitely recognises the issue: "There can be no assurance that integration, and the synergies expected to result, will be achieved to the extent currently anticipated." Weber and Camerer [34] show experimentally that performance can decline substantially after two different cultures merge.

[8] Especially actions during the integration phase are likely to be plagued by misunderstandings, reinforcing ambiguity about what each other is doing (Vaara [31]). A director of DaimlerChrysler stated in 1998: "When you think about the complexity of integrating two large companies, you start understanding the uncertainties involved. A gradual integration process can help to give each other time to know the other side better. But, by doing so, you may lose momentum and a real opportunity to make radical transformations." (DaimlerChrysler Case Study, Fachhochshule Mainz, 2003).

want to integrate while for low expectations, it would not want to merge. Hence, if all firms receive intermediate signals, merger failure may occur. This failure cannot be avoided by post-merger communication. Each partner has incentives to overstate its private signal, since it always prefers that the others exert integration efforts, even when it does not integrate. Under these conditions, credible communication cannot be supported in equilibrium, as shown by Baliga and Morris [2].

Our analysis allows us to identify under which conditions merger failure actually occurs and to predict when more failures should be expected. First, failures are more likely when opportunity costs of merging are lower. Firms merge more because it is cheaper and integrate less because the partner's merger acceptance gives a less positive signal. Harford [14] and Schleifer and Vishny [28] find evidence that more mergers take place when transaction costs are lower, and that this is typically observed during an economic boom. Our results show that lower costs not only induce more mergers, but also relatively more failures, consistent with the empirical evidence in Harford [14] and Gugler at al. [12] of more failures occurring during economic booms.

Second, there are less failures if the penalty rises when not reaching a fully integrated company. A higher penalty increases the incentives to integrate at the post-merger stage. It might thus well be that company differences and divergent management styles create opportunities for merger success. This can explain the counterintuitive evidence of Morosini et al. [22], who find a better merger performance for more distinct partners.[9]

And, even though no condition needs to be imposed on the precision of the signals to have the possibility of merger failure, the precision does affect the likelihood of a failure. More noisy signals in the pre-merger stage induce a firm to rely too much on the good news that the partner wants to merge. Thus, less precise information gathered in the pre-merger stage leads to more failures.

A number of other explanations for why mergers fail have been proposed in the literature. Managers can be empire-builders and merge only to belong to a larger firm

[9] Chakrabarti et al. [10] detect this as well. Larsson and Finkelstein [19] discover a positive, although not significant, relationship between cultural distance and organisational integration.

(Berkovitch and Narayanan [5]). Indeed, managers do not necessarily maximise shareholders' utility, but their own, which is typically correlated with the size of their firm. In our explanation, managers' and shareholders' interests are perfectly aligned and still a dissatisfactory merger may occur. And, empire building doesn't explain why relatively more failures occur during booms.

Second, managers may overestimate the future performance of the merged entity because they are over-optimistic about the synergy gains - so-called "managerial hubris" - or because they may not foresee post-merger difficulties.[10,11] Fulghieri and Hodrick [11] link synergies with agency problems in such a way that coordination problems and multiple equilibria arise.[12] If managers foresee that all partners concerned will take the necessary actions to attain a workable merger, but end up in a situation where nobody makes any effort, a failure will occur. But, why the good outcome is thought to prevail a priori and why the bad situation arises in the end is not clear. The whole decision process remains a black box. In such a setup, one cannot predict the occurrence of merger failures in function of the underlying parameters.[13] In our paper, firms make rational choices at each point in time and we succeed to explain why optimal actions may still lead to a

[10] In Banal-Estañol et al.[3] mergers may fail, because managers underestimate internal conflicts. Weber and Camerer [34] report that subjects in the laboratory are not able to foresee the problems derived from conflicting organisational cultures. Van den Steen [32] finds in a general context that differing priors among agents may lead to rational overoptimism about the likelihood of success of the actions undertaken.

[11] There are other reasons for a non-profitable merger to occur. Fridolfsson and Stennek [30] show that mergers may lead to lower profits if being an insider is better than being an outsider. Firms may merge to preempt their partner from merging with a rival. Alternatively, since the net benefits of a merger are uncertain, actual results may be worse than expected. This type of failure is a possibility in this paper. However, failure due to organisational problems may appear well before uncertainty is realised.

[12] Agency conflicts may emerge from a more hierarchical structure of an organisation (Meyer et al. [21]), from divisional rent seeking (Scharfstein and Stein [27]), or simply because of facing a more complex organisation (Weber et al. [35]).

[13] As argued by Morris and Shin [23] in a general context, the apparent coordination problems are a consequence of two simplifying modelling assumptions: payoffs are assumed to be common knowledge and players are assumed to be certain about the others' behaviour in equilibrium. Different beliefs are logically coherent and we end up in an indeterminacy because of self-fulfilling beliefs.

merger failure.

The paper also expands the global games literature, started by Carlsson and van Damme [8] and further developed by Morris and Shin [23]. In these type of games, agents' payoffs (the realised efficiency gains) depend on the action chosen by the other agents (the integration effort) and some unknown economic fundamental (the potential synergy gains). Agents receive public and private signals that generate beliefs about the economic fundamental and about the actions and beliefs of the other agents. Morris and Shin [23] showed that this incomplete information game has a unique equilibrium as long as the public signal is noisy enough. If the public signal becomes too precise, coordination problems and multiple equilibria arise as in the complete information case. In our setting, prior to the global game (the integration stage), there is the decision of whether to participate (the merger decision) that allows players to update their beliefs about the signals of the other players. As a consequence, uniqueness is only ensured when the *private* signals are noisy enough. The decision to participate in the game makes part of this private information public.

The remainder of the paper is organised as follows. Section 2 presents the model. Section 3 links the public information version of our model with some of the previous explanations of merger failures. Section 4 presents our explanation of merger failures using the case in which all information is kept private. Section 5 performs comparative statics and Section 6 extends to the general case where part of the information is shared and part is private. Section 7 concludes. In Appendix A we provide some preliminaries for the proofs, which are relegated to Appendix B.

# 2 Model

Consider two risk-neutral firms with distinct corporate cultures. Both examine the possibility to merge. If the merger does not occur, each of them will earn the deterministic stand-alone profits $\pi^s > 0$.[14] Merging profits, on the other hand, are uncertain. Indeed, they depend on the combination's uncertain potential synergy gains, $\theta \in \mathbb{R}$, and on the extent to which these gains will be actually realised in the post-merger integration process. Accordingly, the merging profits for each, gross of merging and integration costs, can be written as $\pi^m(f\theta)$, where $f \in [0,1]$ represents the degree of fulfillment of the potential synergy gains and $\pi^m(\cdot)$ is an increasing function. We consider thus a merger of equals, whereby profits are shared equally. Each firm needs to pay a fixed cost $k$ for merging and may have to incur further integration costs $t$ during the post-merger process.

We analyse the merger process by using a four-stage game. In the pre-merger period (first stage), both firms collect information about the potential synergy gains. In the merger period (second and third stages), firms decide whether to merge. In the second stage, the firm denoted as Firm 1 decides whether to propose a merger to the other firm, Firm 2, that can accept or reject in the third stage.[15] If both agree to merge, then in the post-merger period (fourth stage), each decides whether to exert an integration effort. Finally, the synergy gains and therefore the profits from merging are realised. The timing of the game is described in Figure 1.

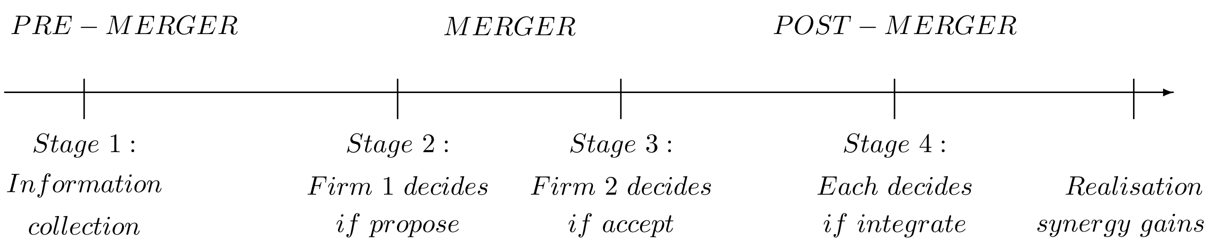


Figure 1: Timing of the Game.

In the first stage, both firms collect information about the potential synergy gains.

[14] Past and current profits give a reasonably accurate idea of profits in the immediate future if the market structure does not change.

[15] Merger decisions are modeled as sequential decisions to avoid the equilibrium where both firms decide not to merge for any level of gains. This equilibrium appears only when firms take the merger decision at exactly the same point in time.

Before any information gathering, the synergy gains are completely uncertain and therefore $\theta$ is a priori randomly drawn from the real line, with each realisation equally likely.[16] Collected information can be classified into public, available to both firms, and private, available to only one. The knowledge that becomes available to both firms is assumed to be summarised in a noisy, public signal of the true synergies,

$$y = \theta + \upsilon. \tag{1}$$

Parameter $\upsilon$ represents the noise and we presume $\upsilon \sim U(-l, l)$, and $\upsilon$ and $\theta$ to be independent. The information derived from non-shared research and knowledge is summarised into two noisy private signals of the true synergies,

$$x_i = \theta + \varepsilon_i \text{ for } i = 1, 2, \tag{2}$$

where $\varepsilon_i$ represents the noise. It is assumed that the $\varepsilon_i$ are i.i.d. with $\varepsilon_i \sim U(-l, l)$ and $\varepsilon_i$ and $\theta$, $\varepsilon_i$ and $\upsilon$ are independent. For simplicity, we set the three signals equally precise.

In the second stage, Firm 1 decides whether to propose to Firm 2. Equivalently, Firm 1 is the first firm to publicly announce whether it agrees to merge.[17] It uses the available information, $I_1^m \equiv \{x_1, y\}$, to update its beliefs about the potential synergy gains, $(\theta \mid I_1^m)$ and its beliefs about the private signal received by Firm 2, $(x_2 \mid I_1^m)$. If Firm 1 decides not to propose, both firms obtain the stand-alone profits, $\pi^s$, and the game ends. If it decides to propose, then it is Firm 2's turn to respond.

In the third stage, Firm 2 decides whether to accept or reject the proposal, based on its available information $I_2^m \equiv \{x_2, y, \text{Firm 1 agreed to merge}\}$. It can reject and terminate the game, resulting into the stand-alone profits $\pi^s$ for each firm. If on the other hand, Firm 2 accepts, the merger takes place. Each firm pays the merging costs $k$ and becomes

[16] The assumption that $\theta$ is uniformly distributed on the real line is non-standard but presents no technical difficulties. Such "improper priors" with infinite mass are well behaved as long as we are concerned only with conditional beliefs. See Hartigan [15] for a discussion on improper beliefs. An improper belief is the same as assuming that the prior distribution of $\theta$ becomes diffuse.

[17] We will show that the order in which firms announce their decision does not matter. It would be therefore equivalent to assume that only proposals or acceptances are observed.

a unit of the new entity.[18] The two units enter then into the post-merger process.

In the fourth stage, based on the information available, $I_i^p \equiv \{I_i^m$, Firm $j$ agreed to merge$\}$, each unit decides simultaneously whether to exert an integration effort in order to adapt towards the other's culture. We assume that the cultures at the beginning, $C_1^B$ and $C_2^B$, as well as the cultures at the end, $C_1^A$ and $C_2^A$, can be represented on the real line. Unit $i$ can change at a cost $t$ its initial culture for the intermediate one

$$C_i^A = \begin{cases} C_i^B & \text{if } e_i = 0 \\ \frac{C_1^B + C_2^B}{2} & \text{if } e_i = 1, \end{cases}$$

where $e_i = 1, 0$ represents whether it exerts effort.[19]

Realised synergy gains depend on the similarity of the cultures at the end of the integration process and hence on the distance between $C_1^A$ and $C_2^A$, $f\left(\left|C_1^A - C_2^A\right|\right)$, where

$$\left|C_1^A - C_2^A\right| = \begin{cases} 0 & \text{if } e_1 = e_2 = 1 \\ \frac{\left|C_1^B - C_2^B\right|}{2} & \text{if } e_1 \neq e_2 \\ \left|C_1^B - C_2^B\right| & \text{if } e_1 = e_2 = 0. \end{cases}$$

More disparate cultures lower the extent of the synergy gains obtained, $f(\cdot)$ is decreasing. Given that we model integrating as a binary decision, there are three scenarios. When both partners adapt towards each other, $f(0) = 1$ and synergy gains are not discounted. If only one partner integrates, the discount factor is $f\left(\frac{\left|C_1^B - C_2^B\right|}{2}\right)$, which for expositional ease we denote as $f\left(\frac{\left|C_1^B - C_2^B\right|}{2}\right) \equiv \frac{1}{d}$, where $d > 1$. Finally, when no one does an integration effort, we let the penalty to be extremely high, $f\left(\left|C_1^B - C_2^B\right|\right) = 0$, and zero merger gains are obtained.[20] The uncertain gross payoffs for each firm are represented in Table (3).

[18] We assume that both the costs of merging and the stand-alone profits are certain. Results would not change if these were random, as long as expected values are the same for both firms.

[19] The intermediate point is the natural choice when firms are symmetric. Note that an alternative approach is to assume that partners can change their culture for another one that belongs to the interval $C_i^A \in \left[C_i^B, \frac{C_1^B + C_2^B}{2}\right]$. Given the linearity of the model, this is equivalent to the current approach since the optimal integration decision would be a corner solution.

[20] To fully discount the potential synergies if none does any integration effort is just a normalisation. Alternatively, we could substract the discounted expected synergies from the costs of merging and obtain the same results.

| | Integrate | Not integrate |
|---|---|---|
| Integrate | $\pi^m(\theta) - t\ ,\ \pi^m(\theta) - t$ | $\pi^m(\frac{\theta}{d}) - t\ ,\ \pi^m(\frac{\theta}{d})$ |
| Not integrate | $\pi^m(\frac{\theta}{d})\ ,\ \pi^m(\frac{\theta}{d}) - t$ | $\pi^m(0)\ ,\ \pi^m(0)$ |

(3)

We assume that $k + \pi^s > \pi^m(0)$. Then, if the merger goes ahead but no unit does an integration effort, the profits from merging do not cover the opportunity costs of merging, independently of the realisation of $\theta$.

**Definition 1** *If both firms agree to merge but none does any integration effort, the merger is a sure failure.*

For simplicity, we let $\pi^m(f\theta) = f\theta$ and normalise the integration costs $t$ to 1. Then, the sure failure assumption is satisfied, since $k + \pi^s > 0$. Further, efforts are strategic complements if and only if $d > 2$.

# 3 Public Information and Previous Explanations

To relate our model with previous work, suppose first that firms receive only a public signal $y$. Therefore,

$$E_1(\theta \mid I_1^m) = E_2(\theta \mid I_2^m) = E_1(\theta \mid I_1^p) = E_2(\theta \mid I_2^p) = y.$$

We solve the game by backwards induction. Simple algebra shows that if the expected synergy gains are low, $y < \min\{d, \frac{d}{d-1}\}$, not integrating is a dominant strategy for both firms. Anticipating the outcome of the integrating process, both firms prefer not to incur the opportunity cost of merging, $k + \pi^s$, and call off the merger.

Suppose on the other hand that synergy gains are high, $y > \max\{d, \frac{d}{d-1}\}$. Merging units adapt then towards each other's culture since this is a dominant strategy. Anticipating, firms compare in turn the expected benefits of merging $(y - 1)$ with the opportunity costs of merging $k + \pi^s$ and agree to merge if and only if $y - 1 - k - \pi^s \geq 0$. A first source of failure (*"bad luck failure"*) may occur. If the realised synergy gains are lower than expected and do not compensate the merger and integration costs, the merger is unsuccessful.

Take finally the intermediate case, $\min\{d, \frac{d}{d-1}\} < y < \max\{d, \frac{d}{d-1}\}$. No dominant strategy exists. Moreover, coordination problems arise and the game has two pure strategy Nash equilibria.[21] If $d > 2$, units' actions are strategic complements. A high discount factor induces a firm to incur the integration costs only when it beliefs that its partner integrates. The two partners integrating and none integrating are both Nash equilibria. Units have a mutual interest in reaching one equilibrium. The notion of Nash equilibrium however does not rule out the inferior equilibrium of none integrating.[22]

This indeterminacy is even more problematic when one goes backwards to the merger stage. At the moment of taking merger decisions, firms do not know in which equilibrium of the integration process they are going to coordinate. This has been used as another possible explanation of a merger failure (*"irrational failure"*). Both firms may agree to merge, the argument goes, expecting that they are going to reach the good equilibrium, but for some reason end up in the bad one.[23]

If firms are rational, the game has two Subgame Perfect Nash equilibria. In the first, both firms merge and both integrate and in the second, none of them merges or integrates. Our discussion in this section can be summarised in the following lemma.

LEMMA 1 *When all information about uncertain synergy gains is shared among merger partners, a merger failure can only occur because of irrationality or bad luck.*

In the following section, we present our explanation of merger failures. The key element

[21] There also exists a mixed strategy Nash equilibrium. Throughout the paper however we concentrate on pure strategy equilibria.

[22] In the other case where $d \in (1, 2]$, integration decisions are strategic substitutes. Since the discount factor is low, a firm prefers not to incur the integration costs when it beliefs that its partner integrates. Two equilibria arise: one partner, but not the other, does integration efforts and vice versa. But, as argued in the introduction, we concentrate on the case where integration decisions are strategic complements.

[23] Notice that this type of failure occurs for any realised value of the synergies. This never occurs in the case of strategic substitutes. For both Nash equilibria, there is one firm that does an integration effort and the merger is not a sure failure.

of our explanation is the introduction of asymmetric information.

# 4 Private Information and Rational Merger Failures

In the previous section, we assumed that all the information collected by the merging firms was shared. In practice this is rarely the case. Firms often hide at least part of their information.[24] In the rest of the paper, firms hold some private information. In addition to add reality to the model, we find a unique equilibrium. This is not only of theoretical interest. It also allows us to perform comparative statics.

To simplify our discussion, we consider first the case in which firms receive only a private signal. A strategy in this setting does not consist of two binary decisions as in the public information case, but in a mapping from the range of possible signals to those two binary choices.[25]

**Definition 2** *A strategy $s_i$ for Firm $i$, $i = 1, 2$, is a function specifying, for each possible private signal $x_i \in \mathbb{R}$, an action*

$$\begin{aligned} s_1 &: \mathbb{R} \rightarrow [\{\textit{Propose, Not propose}\}, \{\textit{Integrate, Not integrate}\}] \textit{ and} \\ s_2 &: \mathbb{R} \rightarrow [\{\textit{ Accept, Not accept }\}, \{\textit{Integrate, Not integrate}\}]. \end{aligned}$$

We concentrate on monotonic strategies, which in binary choice settings is equivalent to the class of switching strategies. Depending on whether the signal is below or above a cutoff point, the player takes one action or the other. In our case, since we have two decisions, a strategy is uniquely defined by two cutoff points.

[24] Brusco et al. [7] identify necessary and sufficient conditions for the implementability of incentive-efficient mechanisms when efficiency gains are not dependent on post-merger actions. Their results, however, cannot be directly applied here because firms' revelation of information would affect their post-merger actions and therefore the extend of the synergy realisation.

[25] Remember that Firm 2 only decides whenever Firm 1 has proposed. Similarly, the two firms have only to decide upon integrating whenever both firms have agreed to merge. This means that strategies are fully defined without specifying the action of the other.

**Definition 3** *A double switching strategy $s_i$ for Firm $i$, $i = 1, 2$, with cutoffs $\widetilde{x}_i$ and $\widetilde{\widetilde{x}}_i$ for merging and integrating respectively, can be described as*

$$s_1(x_1) = \begin{cases} \textit{Propose} & \textit{iff } x_1 > \widetilde{x}_1 \\ \textit{Integrate} & \textit{iff } x_1 > \widetilde{\widetilde{x}}_1 \end{cases}$$

$$\textit{and } s_2(x_2) = \begin{cases} \textit{Accept} & \textit{iff } x_2 > \widetilde{x}_2 \\ \textit{Integrate} & \textit{iff } x_2 > \widetilde{\widetilde{x}}_2. \end{cases}$$

The sequential ordering introduces an informational asymmetry. The first-mover firm, Firm 1, has to take the proposing decision without knowing whether Firm 2 will accept or reject later on. The following lemma shows that in practice there is no asymmetry.

Lemma 2 *When deciding wether to propose, Firm 1 decides as if it knew that Firm 2 were going to accept. As a result, both firms take the merger decision based on the same information, $I_i \equiv \{x_i, x_j \geq \widetilde{x}_j\}$, for $i = 1, 2$ and $i \neq j$.*

Firm 1's decision is only relevant when Firm 2 accepts the merger because the stand-alone profits do not depend on who rejects the merger. This is a realistic assumption if the rejection of the merger does not provide any additional information about the individual firm's ability to compete in the product market. Since the information collected is about the synergy gains from merging and the prospects of the combined entity, it is unlikely that a rejection provides information.[26] Given this result, we denote from now on for expositional ease both the *Propose* and *Accept* decisions as *Merge*, and similarly *Not Propose* and *Not Accept* as *Not Merge*.

From Table (3), if Firm $j$ chooses a double switching strategy around $(\widetilde{x}_j, \widetilde{\widetilde{x}}_j)$, Firm $i$ integrates whenever

$$g(x_i, \widetilde{x}_j, \widetilde{\widetilde{x}}_j) \equiv E(\theta \mid I_i) \left[1 + (d-2) \Pr ob \left(x_j \geq \widetilde{\widetilde{x}}_j \mid I_i\right)\right] - d \geq 0. \tag{4}$$

[26] If the asymmetry in information comes mainly from firms' individual characteristics, this might not be true. Hvidd and Prendergast [17] show how a failed takeover bid may increase the profitability of the target by revealing that has low costs. In our framework, the only uncertainty comes from the synergies and therefore from the profitability of the merger, not from the benefits of the separate entities.

Intuitively, a higher private signal $x_i$ raises the expected synergies and the probability that the partner integrates (remember that $I_i \equiv \{x_i, x_j \geq \widetilde{x}_j\}$). Thus, Firm $i$ integrates more. Similarly, when Firm $j$ is less prone to merge ($\widetilde{x}_j$ is higher), its acceptance to merge is a better signal for Firm $i$, inducing this firm to integrate more.

Condition (4) uniquely defines an integration cutoff $\widetilde{\widetilde{x}}_i$ for each double switching strategy of the other firm $(\widetilde{x}_j, \widetilde{\widetilde{x}}_j)$. Firm $i$ integrates if and only if $x_i \geq \widetilde{\widetilde{x}}_i$. Hence, Firm $i$ already knows at the merger stage whether it is going to integrate later on. If Firm $i$ knows that it would integrate in the post-merger stage, it merges whenever

$$h\left(x_i, \widetilde{x}_j, \widetilde{\widetilde{x}}_j\right) \equiv E\left(\theta \mid I_i\right)\left[1 + (d-1)\Pr ob\left(x_j \geq \widetilde{\widetilde{x}}_j \mid I_i\right)\right] - d(1 + k + \pi^s) \geq 0. \qquad (5)$$

Condition (5) uniquely defines a cutoff $\widetilde{x}_i$ for each double switching strategy of the other firm $(\widetilde{x}_j, \widetilde{\widetilde{x}}_j)$. Similarly, if Firm $i$ knows that it would not integrate later on, it merges whenever

$$m\left(x_i, \widetilde{x}_j, \widetilde{\widetilde{x}}_j\right) \equiv E(\theta \mid I_i)\Pr ob\left(x_j \geq \widetilde{\widetilde{x}}_j \mid I_i\right) - d(k + \pi^s) \geq 0. \qquad (6)$$

Given the symmetry of the model, we concentrate on equilibria in the class of symmetric strategies whereby partners $i$ and $j$ play the same double switching strategy, $\widetilde{x}_i = \widetilde{x}_j \equiv \widetilde{x}$ and $\widetilde{\widetilde{x}}_i = \widetilde{\widetilde{x}}_j \equiv \widetilde{\widetilde{x}}$. We proceed in three steps. In a first step, we provide necessary and sufficient conditions for double switching strategies to be symmetric equilibria. In a second step, it is shown that, provided that the information gathered carries some noise, there exists a unique equilibrium for each combination of the exogenous parameters.[27] In a last step, we find the unique equilibrium in function of these parameters.

Lemma 3 *: characterisation of the equilibrium.*

*A pair of cutoffs* $(\widetilde{x}, \widetilde{\widetilde{x}})$ *is an equilibrium in symmetric switching strategies iff*
*a)* $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0, h(\widetilde{x}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ *and* $\widetilde{x} \geq \widetilde{\widetilde{x}}$ *or*
*b)* $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0, m(\widetilde{x}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ *and* $\widetilde{x} \leq \widetilde{\widetilde{x}}$.

[27] Uniqueness of equilibrium is not straightforward in our game. Although integration decisions are strategic complements with respect to each other, merger and integration decisions are not. For a comprehensive analysis of games with strategic complementarities see Vives [33].

An equilibrium in both stages is found by the intersection of the integration decision function, implicitly defined by $g(\cdot) = 0$, and *either* the "I-will-later-integrate" merger decision function ($h(\cdot) = 0$) *or* the "I-will-later-NOT-integrate" merger decision function ($m(\cdot) = 0$). The first intersection is an equilibrium if and only if in this intersection, firms integrate for a larger range of private signals than they merge ($\widetilde{x} \geq \widetilde{\widetilde{x}}$). Indeed, if the private signal is higher than the integration cutoff ($x_i \geq \widetilde{\widetilde{x}}$), a firm merges when the private signal is higher than the merger cutoff ($x_i \geq \widetilde{x}$). On the other hand, if the private signal is lower than the integration cutoff ($x_i < \widetilde{\widetilde{x}}$), the firm would never merge. An intersection where $\widetilde{\widetilde{x}} > \widetilde{x}$ can never be an equilibrium. When the private signal is below the integration cutoff ($x_i < \widetilde{\widetilde{x}}$), the "I-will-later-integrate" merger function is not defined. The same reasoning holds for the other intersection.

The next step is to show that when the private signal has enough noise there exists a unique pair that satisfies (a) or (b) of the previous lemma, and therefore there exists a unique equilibrium.

PROPOSITION 1 : EXISTENCE AND UNIQUENESS OF THE EQUILIBRIUM.

*If* $l \geq l^* \equiv \frac{3d(d-2)}{2(d-1)^2}$, *there is a unique equilibrium in symmetric switching strategies* $(\widetilde{x}, \widetilde{\widetilde{x}})$.

The merger decision of each firm transforms part of its private information into public. Public information has a "multiplier effect" on all actions, because both firms know that the partner received the same information. Public signals, therefore, play a role in coordinating outcomes that exceeds the information content. Thus, the problem of self-fulfilling beliefs arises again. This is a feature that keeps on returning in global games literature (see Morris and Shin [23]). The particular feature here however is that the *private* signal becomes partly public through the merger decision. Thus, in order to have uniqueness, we need to have some noise on the private signal. We are now able to characterise this unique equilibrium in function of the parameters of our model.

Proposition 2 : Equilibrium.

*Defining* $x^* \equiv \frac{d}{d-1} - \frac{l}{3}$*, the symmetric switching equilibrium* $(\widetilde{x}, \widetilde{\widetilde{x}})$ *satisfies:*

*a) If* $k + \pi^s = \frac{1}{d-1}$ *then* $\widetilde{x} = x^* = \widetilde{\widetilde{x}}$.

*b) If* $k + \pi^s > \frac{1}{d-1}$ *then* $\widetilde{x} > x^* > \widetilde{\widetilde{x}}$.

*c) If* $k + \pi^s < \frac{1}{d-1}$ *then* $\widetilde{x} < x^* < \widetilde{\widetilde{x}}$.

First, for a special case of the exogenous parameters, merger and integrating decisions are the same. Firms find it profitable to merge in the same cases where they optimally integrate (part a). Second, if the opportunity costs of merging are higher, then merging becomes more expensive. As a direct consequence, firms merge less and the cutoff from merging is higher than before. Indirectly, since the acceptance of merging transmits a more positive signal, firms integrate more easily than before and the cutoff from integrating is lower (part b). Finally, following the same reasoning, if the opportunity costs of merging are lower firms merge more and integrate less (part c).

We are now ready to give our explanation of merger failures. In the next corollary we describe when firms rationally choose to merge and not to exert integration efforts.

Corollary 1 : Rational Merger Failures.

*When all information about uncertain synergy gains is kept private among merger partners, rational merger failures occur when*

*a)* $k + \pi^s < \frac{1}{d-1}$*, and*

*b)* $\widetilde{x} < x_i < \widetilde{\widetilde{x}}$ *for* $i = 1, 2$.

A rational merger failure can only occur if both firms choose to merge but not to integrate. For this to happen, it is necessary that the merger decision is taken more easily than the integration decision, i.e. in equilibrium one must have $\widetilde{x} < \widetilde{\widetilde{x}}$. This occurs when the opportunity costs of merging are low and/or the penalty of not being in a common corporate culture is high, $k + \pi^s < \frac{1}{d-1}$ (see Proposition 2). In order to have then a *de facto* failure, it must be that the private signals received by both partners are intermediate, $\widetilde{x} < x_i < \widetilde{\widetilde{x}}$ for $i = 1, 2$. Both firms have gathered information about the synergies, good enough to merge but not good enough to integrate. Both firms merge and expect the partner to do the integration efforts. The merger goes ahead, but both choose not to integrate, a merger failure independent of the realisation of the synergy gains.

If the private signal of at least one firm is below $\widetilde{x}$ then the merger does not go ahead. If, on the other hand, the signal of at least one of them is above $\widetilde{\widetilde{x}}$, then there can be only a failure because of a low realisation. Finally, if condition (b) is not satisfied and $k + \pi^s \geq \frac{1}{d-1}$, then $\widetilde{x} \geq \widetilde{\widetilde{x}}$ and a rational merger failure cannot occur, since firms will always integrate if they merge. We now turn to the comparative statics.

# 5 Comparative Statics

In the previous section, we showed that our game has a unique equilibrium in the class of switching strategies if the private signal is not very precise. Here, we exploit this property to analyse which situations should lead to more merger failures. We analyse how the absolute and the relative probability of failure given $\theta$ varies with the exogenous parameters of the model. To avoid uninteresting situations, we concentrate on the cases where it is possible that firms merge ($\widetilde{x} > \theta - l$) and where it is possible that they do not integrate ($\widetilde{\widetilde{x}} \leq \theta + l$). Notice that $\theta - l$ is the minimum possible signal firms can receive and $\theta + l$ the maximum possible signal. The absolute number of failures is given by

$$\Pr ob(\widetilde{x} < x_i < \widetilde{\widetilde{x}} \mid \theta) = \begin{cases} \min\{\widetilde{\widetilde{x}}, \theta + l\} - \max\{\widetilde{x}, \theta - l\} & \text{if } \widetilde{x} \leq \widetilde{\widetilde{x}} \\ 0 & \text{if } \widetilde{x} > \widetilde{\widetilde{x}}, \end{cases}$$

whereas the relative number of failures is given by

$$\Pr ob(x_i < \widetilde{\widetilde{x}} \mid x_i > \widetilde{x}, \theta) = \begin{cases} \frac{\min\{\widetilde{\widetilde{x}}, \theta+l\} - \max\{\widetilde{x}, \theta-l\}}{\theta+l-\max\{\widetilde{x}, \theta-l\}} & \text{if } \widetilde{x} \leq \widetilde{\widetilde{x}} \\ 0 & \text{if } \widetilde{x} > \widetilde{\widetilde{x}}. \end{cases}$$

First, similar to the intuition provided for Proposition 2, lower opportunity costs of merging lead to a less costly merger and firms therefore more easily merge. This also makes that when the other firm has decided to merge, this yields *less* positive information. Thus, expected synergies and the likelihood of the partner integrating become lower. Hence, the firm is less prone on integrating. The distance between $\widetilde{\widetilde{x}}$ and $\widetilde{x}$ becomes therefore greater and the possibility of a failure higher, both in absolute and relative terms.

Corollary 2 : Opportunity costs of merging.

*Lower opportunity costs of merging ($k+\pi^s$ lower) lead to more mergers ($\widetilde{x}$ lower) and less integration ($\widetilde{\widetilde{x}}$ greater) and therefore to more failures, both in absolute and relative terms.*

The following figure shows as an example both cutoffs for the case in which $d = 3$ and $l = 2$, with $k + \pi^s$ varying from 0 to 1. For $k + \pi^s$ going from 0 to 0.5, $\widetilde{x} < \widetilde{\widetilde{x}}$ and the possibility of failure exists. And, the lower $k + \pi^s$, the bigger the range where failure might occur.

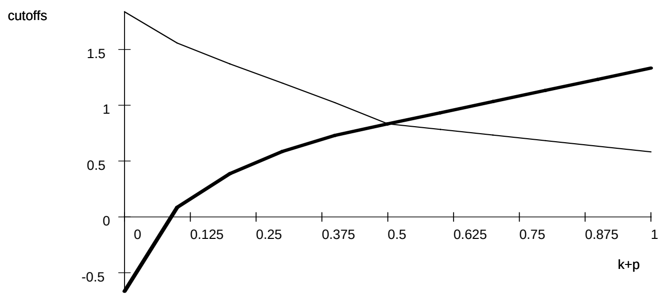


Figure 2: Merging cutoff $\widetilde{x}$ (thick line) and integrating cutoff $\widetilde{\widetilde{x}}$ (dotted line) as a function of the opportunity costs of merging $k + \pi^s$.

We now turn to the comparative statics with respect to the penalty factor $d$ of not fully integrating. Given the complexity of the expressions, we make use of simulation techniques in Mathematica 4.0 to show some of the results.[28] We let $k + \pi^s$ and $l$ range from 0 to 1000 and for every given combination $\{k + \pi^s, l\}$, we let $d$ vary from 2 to $d^{\max}$, where $d^{\max}$ is defined as $l = l^*(d^{\max})$ in order to ensure uniqueness. We find that for each combination of parameters $\{k + \pi^s, l\}$, an increasing $d$ leads to a decrease in $\widetilde{\widetilde{x}}$ and an increase in $\widetilde{x}$. The next figure shows as an example the cutoffs for $\{k + \pi^s, l\} = \{0.3, 2\}$.

[28] All macros and simulation results of this and following exercises are available upon request.

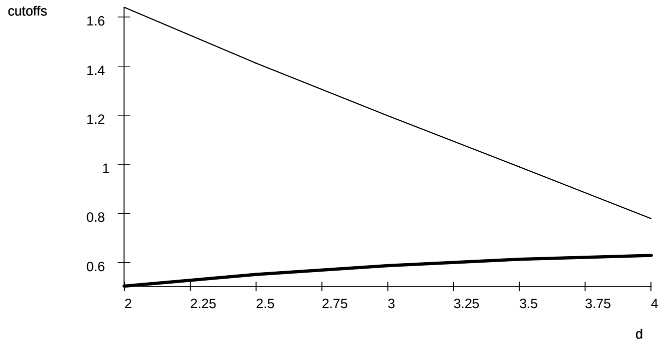


Figure 3: Merging cutoff $\widetilde{x}$ (thick line) and integrating cutoff $\widetilde{\widetilde{x}}$ (dotted line) as a function of the penalty factor $d$ of not fully integrating.

We state findings in the following result.

Result 4 : Penalty factor of not fully integrating.

*A higher penalty factor (d greater) leads to less mergers ($\widetilde{x}$ greater) and more integration ($\widetilde{\widetilde{x}}$ lower), and therefore less rational failures, both in absolute and relative terms.*

A higher penalty factor punishes more non-integration. Thus, *if* firms merge, they are going to more easily integrate. This has as consequence that a Firm $i$ gives a higher probability that its partner will integrate in the post-merger stage. This first effect induces firms to merge more. There is however a stronger effect that goes in the opposite direction. Even though they end up less often in a not fully integrated company, the losses when this happens are higher. As a consequence, firms merge less and integrate more, and thus the possibility for a rational failure becomes smaller.

We finally turn to the effects of having less precise information. This is potentially an important aspect of mergers, since firms often speed up the information gathering process, which leads to less precise information. Again, we computed cutoffs for different values of the exogenous parameters. We let $k + \pi^s$ range from 0 to 1000 and $d$ from 2 to 1000 and for every pair $\{k + \pi^s, d\}$, we let $l$ vary from $l^*$ to 1000, in order to ensure uniqueness. We find that for each combination $\{k + \pi^s, d\}$, an increasing $l$ leads to a slower decrease in $\widetilde{\widetilde{x}}$ than the decrease in $\widetilde{x}$ and thus a larger distance between $\widetilde{\widetilde{x}}$ and $\widetilde{x}$. Figure 4 shows as an example the cutoffs for $\{k+\pi^s, d\} = \{0.25, 3\}$ and $l$ ranging from $l^* = 1.125$ to 3.5.

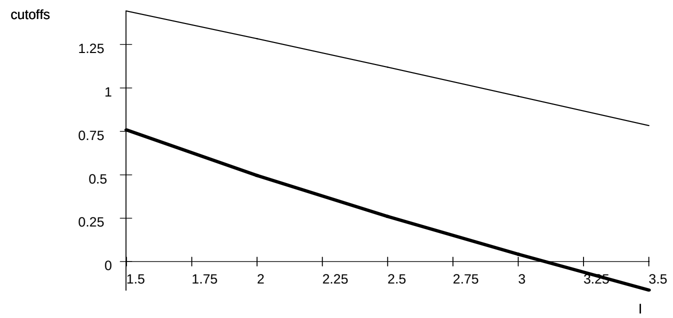


Figure 4: Merging cutoff $\widetilde{x}$ (thick line) and integrating cutoff $\widetilde{\widetilde{x}}$ (dotted line) as a function of the noise $l$ of information.

We state findings in the following result.

Result 5 : Information precision.

*Less precise information ($l$ greater) leads to more mergers ($\widetilde{x}$ lower) and more integration ($\widetilde{\widetilde{x}}$ lower), but to more failures in absolute terms.*

A less precise private signal makes each partner to rely more on the positive signal of the other having merged, when taking integration decisions. This increases the beliefs of a post-merger integration of the partner. Consequently, partners integrate more and, anticipating this, firms merge more. However, since their decisions are based on less information, they lead to more failures.

# 6 Private and Public Information

In this section we briefly consider the case in which firms receive a private and a public signal before merging. The introduction of a public signal $y$ along with the private signals ($x_i$ and $x_j$) does not alter significantly the results of the previous section. Lemmas, Propositions and Proofs can be restated in terms of the two types of information. The uniqueness condition, however, is somewhat more complex and is defined in Appendix B. Nevertheless, noisy enough signals are again sufficient to ensure uniqueness of equilibrium.

Proposition 3 : Extension to private and public information.

*There exists a unique* $l^{**}$ *such that if* $l \geq l^{**}$*, there exists a unique symmetric equilibrium in switching strategies* $(\widetilde{x}, \widetilde{\widetilde{x}})$*. Defining* $r \equiv 3(y - \frac{d}{d-1}) + l$ *and* $x^{**} \equiv y + \frac{(6l-r)-\sqrt{(6l-r)^2+8lr}}{2}$*, the equilibrium is:*

*a) If* $k + \pi^s = \frac{1}{d-1}$ *then* $\widetilde{x} = x^{**} = \widetilde{\widetilde{x}}$*.*

*b) If* $k + \pi^s > \frac{1}{d-1}$ *then* $\widetilde{x} > x^{**} > \widetilde{\widetilde{x}}$*.*

*c) If* $k + \pi^s < \frac{1}{d-1}$ *then* $\widetilde{x} < x^{**} < \widetilde{\widetilde{x}}$*.*

Again merger failures can occur when the opportunity costs of merging are low and the actual signals are intermediate. Similar comparative statics can be performed for this case and the results are analogous.

# 7 Conclusion

This paper proposes a novel explanation of why mergers fail, based on pre-merger gathering of information and post-merger integration problems. Rational managers acting in the interest of shareholders may still lead their firms into merger failures. We show that a firm may agree to merge and abstain from putting forth any integration effort, counting on the partner to adapt. If the two partners follow the same course of actions, the merger goes ahead but fails. The new company does not forge the minimum progress towards a common corporate culture, which is necessary to benefit those synergy gains that would at least cover the merging opportunity costs.

We identify under which conditions mergers are more likely to fail. Lower merging costs not only induce firms to merge more but also to integrate less. Failures should therefore be more likely both in absolute and relative terms when transaction costs are lower, which is the case in economic booms. Our explanation, thus, is consistent with the empirical observation that there are relatively more failures during booms.

Further, a lower penalty for not fully integrating makes merging partners less willing to integrate, resulting in more failures. There is empirical evidence partners with a larger cultural difference perform better. There is, however, no conclusive evidence. When partners are a priori more dissimilar, not only the penalty becomes higher, but also the cost of integrating itself, which is a constant in our model. Both effects pull in opposite directions and their effect on failures cannot be predicted. However, there is experimental evidence in an analogue complete information setup. Battalio et al. [4] show in a coordination game that when the payoff increases of the situation "I-don't-cooperate-and-you-cooperate", then players coordinate less frequent on the best outcome of both cooperating.

Finally, having less precise information on potential synergy gains leads to more failures: firms rely too much on the good news of the partner's positive decision to merge. There is anecdotal evidence that merger failure is more eminent when potential partners spend too little time on information gathering. But systematic empirical testing is difficult. Potential partners keep the starting point of merger talks secret. It is possible to incorporate this in a merger experiment, modifying, for example, the experiments of Weber et al. [34].

Our reasoning can be extended to asymmetric mergers, whereby the smaller partner may need to adapt more to the larger one than vice versa. As long as both units need to exert some effort to make the merger work, they may find it optimal to merge and try to free-ride on each other after the merger. We believe that in all cases, even in a pure takeover, the acquiring firm needs to adapt itself minimally towards the target to reach a workable entity.

# Appendix A: Beliefs

## Synergy gains

If $\theta$ is a random variable with an improper distribution and firm $i$ receives a private signal $x_i = \theta + \varepsilon_i$, where $\varepsilon_i \sim U(-l, l)$ with $\varepsilon_i$ and $\theta$ independent, we have that $\theta \mid x_i \sim U(x_i - l, x_i + l)$. If firms also receive a public signal $y$ such that $y = \theta + \upsilon$ with $\upsilon \sim U(-l, l)$, and $\theta$ and $\upsilon$, and $\varepsilon_i$ and $\upsilon$ are independent, then, since $\theta \mid x_i$ and $\upsilon$ are uniform, $(\theta \mid x_i) \mid (y \mid x_i)$ is also uniform, $\theta \mid y, x_i \sim U(\min\{y, x_i\} + l, \max\{y, x_i\} - l)$.

## Other's signal

Firm $i$ does not observe firm $j$'s private signal, $x_j$, but knows that $x_j = \theta + \varepsilon_j$ where $\varepsilon_j \sim U(-l,l)$ and $\varepsilon_j$ and $\theta$, $\varepsilon_j$ and $\varepsilon_i$ are independent. Since $\theta \mid x_i$ and $\varepsilon_j$ are uniforms, we know that $x_j \mid x_i$ is a sum of uniforms, which results in a distribution function with density function,

$$f(x_j \mid x_i) = \begin{cases} \frac{x_j - x_i + 2l}{(2l)^2} & \text{if } x_j \in [x_i - 2l, x_i] \\ \frac{x_i + 2l - x_j}{(2l)^2} & \text{if } x_j \in [x_i, x_i + 2l], \end{cases}$$

and we can obtain $\Pr ob\left(x_j \geq \widetilde{\widetilde{x}}_j \mid x_i, x_j \geq \widetilde{x}_j\right) = \frac{\Pr ob(x_j \geq \widetilde{\widetilde{x}}_j | x_i)}{\Pr ob(x_j \geq \widetilde{x}_j | x_i)}$. Similarly, if the firms receive a public signal, since $\theta \mid y, x_i$ and $\varepsilon_j$ are uniforms, we know that $x_j \mid y, x_i$ is again a sum of uniforms, which results in a distribution function with density function,

$$f(x_j \mid x_i, y) = \begin{cases} \frac{x_j - (\max\{y, x_i\} - 2l)}{2l(2l - (\max\{y, x_i\} - \min\{y, x_i\}))} & \text{if } x_j \in [\max\{y, x_i\} - 2l, \min\{y, x_i\}] \\ \frac{1}{2l} & \text{if } x_j \in [\min\{y, x_i\}, \max\{y, x_i\}] \\ \frac{\min\{y, x_i\} + 2l - x_j}{2l(2l - (\max\{y, x_i\} - \min\{y, x_i\}))} & \text{if } x_j \in [\max\{y, x_i\}, \min\{y, x_i\} + 2l], \end{cases}$$

and from here we can obtain $\Pr ob\left(x_j \geq \widetilde{\widetilde{x}}_j \mid x_i, x_j \geq \widetilde{x}_j, y\right) = \frac{\Pr ob(x_j \geq \widetilde{\widetilde{x}}_j | x_i, y)}{\Pr ob(x_j \geq \widetilde{x}_j | x_i, y)}$.

## Merger Updating

We can find $\theta \mid x_i, x_j \sim (\theta \mid x_i) \mid (x_j \mid x_i)$ which is a uniform again, because $x_j \mid x_i$ is a sum of two uniform distributions and $(\theta \mid x_i)$ is a uniform. We have then $\theta \mid x_i, x_j \sim U[\min\{x_i, x_j\} + l, \max\{x_i, x_j\} - l\}]$. From here, we can obtain $E(\theta \mid x_i, x_j \geq \widetilde{x}_j) = \frac{\int_{x_j \geq \widetilde{x}_j} \int_\theta \theta f(\theta | x_i, x_j) d\theta dx_j}{\Pr ob(x_j \geq \widetilde{x}_j | x_i)}$. Similarly, if the firms receive a public signal, $\theta \mid x_i, x_j \sim U[\min\{x_i, x_j, y\} + l, \max\{x_i, x_j, y\} - l\}]$ and $E(\theta \mid x_i, x_j \geq \widetilde{x}_j, y) = \frac{\int_{x_j \geq \widetilde{x}_j} \int_\theta \theta f(\theta | x_i, x_j, y) d\theta dx_j}{\Pr ob(x_j \geq \widetilde{x}_j | x_i, y)}$.

# Appendix B: Proofs

## Proof of Lemma 2

Firm $1's$ payoff from proposing the merger depends on the probability that Firm 2 agrees to merge. From the Law of Total Expectations, we can write Firm 1's payoff by proposing the merger as $[E(\pi^m(\cdot) \mid I_1^m, x_2 \geq \widetilde{x}_2) - k] \Pr ob(x_2 \geq \widetilde{x}_2 \mid I_1^m) + \pi^s \Pr ob(x_2 < \widetilde{x}_2 \mid I_1^m)$. Firm 1 agrees to propose as long as this expression is greater than $\pi^s$ which, simplifying, amounts to the condition $E(\pi^m(\cdot) \mid I_1^m, x_2 \geq \widetilde{x}_2) - k \geq 0$.

## Proof of Lemma 3

First take a pair $(\widetilde{x}, \widetilde{\widetilde{x}})$ that satisfies part (a) (the same arguments apply for (b)). Suppose that firm $j$ is using this switching strategy with cutoffs $(\widetilde{x}, \widetilde{\widetilde{x}})$. From (4) and by definition of $(\widetilde{x}, \widetilde{\widetilde{x}})$, firm's $i$ best response is to use, in the integration stage, a switching strategy with cutoff $\widetilde{\widetilde{x}}$. Suppose first that firm $i$ receives a private signal $x_i$ below $\widetilde{\widetilde{x}}$. Knowing that it is not going to integrate, we show that it is not going to merge, that is $m(x_i, \widetilde{x}, \widetilde{\widetilde{x}}) < 0$. Since $m()$ is an increasing function of $x_i$ we have then that $m(x_i, \widetilde{x}, \widetilde{\widetilde{x}}) < m(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}})$. By definition of $g, h$ and $m$, we have that $m(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = h(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) - g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}})$. By definition $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ and since $h()$ is an increasing function in $x_i$ and $h(\widetilde{x}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$, it is true that $h(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) < 0$. Hence, $m(x_i, \widetilde{x}, \widetilde{\widetilde{x}}) < 0$ and firm $i$ does not want to merge. Suppose secondly that firm $i$ receives a private signal $x_i$ above $\widetilde{\widetilde{x}}$. Then it is going to merge, knowing that it is going to integrate whenever $x_i \geq \widetilde{x}$ by definition of $h()$. We have shown that firm $i$ is going to merge whenever its private signal is above $\widetilde{x}$.

We now show that a pair $(\widetilde{x}', \widetilde{\widetilde{x}}')$ that satisfies $g(\widetilde{\widetilde{x}}', \widetilde{x}', \widetilde{\widetilde{x}}') = 0$ and $h(\widetilde{x}', \widetilde{x}', \widetilde{\widetilde{x}}') = 0$ but $\widetilde{\widetilde{x}}' > \widetilde{x}'$ is not an equilibrium. Suppose that firm $j$ uses a switching strategy with cutoffs $(\widetilde{x}', \widetilde{\widetilde{x}}')$. Firm's $i$ best response is to use a switching strategy with cutoff $\widetilde{\widetilde{x}}'$ in the integration stage. Suppose that firm $i$ receives a private signal $x_i = \widetilde{x}' - \varepsilon$. Knowing that it does not integrate, it will merge whenever $m(x_i, \widetilde{x}', \widetilde{\widetilde{x}}') \geq 0$. But since $m(x_i, \widetilde{x}', \widetilde{\widetilde{x}}') = h(x_i, \widetilde{x}', \widetilde{\widetilde{x}}') - g(x_i, \widetilde{x}', \widetilde{\widetilde{x}}')$ and $g(x_i, \widetilde{x}', \widetilde{\widetilde{x}}') < 0$ and $h(x_i, \widetilde{x}', \widetilde{\widetilde{x}}')$ is arbitrarily close to 0 when $\varepsilon$ tends to 0, $m(x_i, \widetilde{x}', \widetilde{\widetilde{x}}') > 0$ and it will merge. Then $\widetilde{x}'$ cannot be a cutoff point.

## Proof of Proposition 1

From (4), we have

$$g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = E(\theta \mid \widetilde{\widetilde{x}}, x_j \geq \widetilde{x}) \left[1 + (d-2) \Pr ob \left(x_j \geq \widetilde{\widetilde{x}} \mid \widetilde{\widetilde{x}}, x_j \geq \widetilde{x}\right)\right].$$

Clearly, $E(\theta \mid \widetilde{\widetilde{x}}, x_j \geq \widetilde{x})$ and $\Pr ob(x_j \geq \widetilde{\widetilde{x}} \mid \widetilde{\widetilde{x}}, x_j \geq \widetilde{x})$ are increasing functions of $\widetilde{x}$ and therefore $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}})$ is also increasing in $\widetilde{x}$. As shown in Appendix A, we can obtain for the uniform distribution that if $\widetilde{\widetilde{x}} \geq \widetilde{x}$,

$$g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = \frac{6\widetilde{\widetilde{x}}(2l)^2 - (\widetilde{x} + 2\widetilde{\widetilde{x}} - l)(\widetilde{x} - \widetilde{\widetilde{x}} + 2l)^2}{6(2l)^2 - 3(\widetilde{x} - \widetilde{\widetilde{x}} + 2l)^2} \left[1 + (d-2)\frac{2\,(2l)^2}{2\,(2l)^2 - (\widetilde{x} - \widetilde{\widetilde{x}} + 2l)^2}\right],$$

whereas if $\widetilde{\widetilde{x}} < \widetilde{x}$,

$$g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = \frac{2\widetilde{\widetilde{x}} + l + \widetilde{x}}{3}(d-1) - d.$$

We can show that when $l \geq \frac{3d(d-2)}{2(d-2)^2}$, then $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}})$ is also increasing in $\widetilde{\widetilde{x}}$. By the implicit function theorem, we get that $\widetilde{\widetilde{x}}$, such that $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ is a decreasing function of $\widetilde{x}$. Similarly we can show that $h(\widetilde{x}', \widetilde{x}', \widetilde{\widetilde{x}}')$ and $m(\widetilde{x}'', \widetilde{x}'', \widetilde{\widetilde{x}}'')$ are increasing functions of $\widetilde{x}'$ and decreasing of $\widetilde{\widetilde{x}}'$. Again by the implicit function theorem we have then that $\widetilde{x}'$ and $\widetilde{x}''$, such that $h(\widetilde{x}', \widetilde{x}', \widetilde{\widetilde{x}}') = 0$ and that $m(\widetilde{x}'', \widetilde{x}'', \widetilde{\widetilde{x}}'') = 0$, are decreasing functions of $\widetilde{\widetilde{x}}'$ and $\widetilde{\widetilde{x}}''$, respectively. Therefore there is a unique pair $(\widetilde{x}, \widetilde{\widetilde{x}})$ such that $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ and $h(\widetilde{x}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ and a unique pair $(\widetilde{x}', \widetilde{\widetilde{x}}')$ such that $g(\widetilde{\widetilde{x}}', \widetilde{x}', \widetilde{\widetilde{x}}') = 0$ and $m(\widetilde{x}', \widetilde{x}', \widetilde{\widetilde{x}}') = 0$.

Suppose first that $\widetilde{x} \leq \widetilde{\widetilde{x}}$ such that $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ and $h(\widetilde{x}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$. This is by definition an equilibrium and we need to show that $(\widetilde{x}', \widetilde{\widetilde{x}}')$ such that $g(\widetilde{\widetilde{x}}', \widetilde{x}', \widetilde{\widetilde{x}}') = 0$ and $m(\widetilde{x}', \widetilde{x}', \widetilde{\widetilde{x}}') = 0$ is not. Since $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ and $h(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) \geq h(\widetilde{x}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$, we have that $m(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = h(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) - g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) \geq 0$. Since $\widetilde{\widetilde{x}}(\widetilde{x})$ such that $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ is a decreasing function, the combination $(\widetilde{x}', \widetilde{\widetilde{x}}')$ such that $g(\widetilde{\widetilde{x}}', \widetilde{x}', \widetilde{\widetilde{x}}') = 0$ and $m(\widetilde{x}', \widetilde{x}', \widetilde{\widetilde{x}}') = 0$ should satisfy $\widetilde{x}' \leq \widetilde{x}$ and $\widetilde{\widetilde{x}}' \geq \widetilde{\widetilde{x}}$. But then, since $\widetilde{x} \leq \widetilde{\widetilde{x}}$, then $\widetilde{x}' \leq \widetilde{\widetilde{x}}'$ and therefore, from the previous lemma $(\widetilde{x}', \widetilde{\widetilde{x}}')$ cannot be an equilibrium. If, secondly, $\widetilde{x} > \widetilde{\widetilde{x}}$ then $(\widetilde{x}, \widetilde{\widetilde{x}})$ is not an equilibrium by the previous lemma. However, following a similar reasoning as above we can show that $\widetilde{x}' > \widetilde{\widetilde{x}}'$ and therefore $(\widetilde{x}', \widetilde{\widetilde{x}}')$ is an equilibrium.

## Proof of Proposition 2

(a) Since $E(\theta \mid \widetilde{x}, x_j \geq \widetilde{x}) = \frac{1}{d-1}$ and $\Pr ob(x_j \geq \widetilde{x} \mid \widetilde{x}, x_j \geq \widetilde{x}) = 1$, we have that when $k + \pi^s = \frac{1}{d-1}$, $g(\widetilde{x}, \widetilde{x}, \widetilde{x}) = h(\widetilde{x}, \widetilde{x}, \widetilde{x}) = m(\widetilde{x}, \widetilde{x}, \widetilde{x}) = 0$. Since, by the previous proposition there is a unique equilibrium, we have that $(\widetilde{x}, \widetilde{\widetilde{x}})$ is such that $\widetilde{\widetilde{x}} = \widetilde{x}$ is the unique equilibrium, proving part a). In fact, it can easily be proven that $\widetilde{\widetilde{x}} = \widetilde{x} = \frac{d}{d-1} - \frac{l}{3}$.

(b) When $k + \pi^s > \frac{1}{d-1}$ then $h(\widetilde{x}, \widetilde{x}, \widetilde{x}) = m(\widetilde{x}, \widetilde{x}, \widetilde{x}) < 0$ and following an argument similar to the one presented in the proof of the previous proposition, we can show that the equilibrium satisfies part a) in Lemma 3. On the other hand when $k + \pi^s < \frac{1}{d-1}$ then $h(\widetilde{x}, \widetilde{x}, \widetilde{x}) = m(\widetilde{x}, \widetilde{x}, \widetilde{x}) > 0$ and then the equilibrium satisfies part b) in Lemma 3.

## Proof of Corollary 1

Follows directly from Proposition 2.

## Proof of Corollary 2

A lower $k$ (or a lower $\pi^s$) decreases $h()$ and $m()$ leaving $g()$ constant. Therefore, by the implicit function theorem and the proof of Proposition 2 that $h()$ and $m()$ are increasing functions of $\widetilde{x}$, $\widetilde{x}(\widetilde{\widetilde{x}}, k + \pi^s)$ such that $h(\widetilde{\widetilde{x}}', \widetilde{x}', \widetilde{\widetilde{x}}', k + \pi^s) = 0$ or $m(\widetilde{\widetilde{x}}', \widetilde{x}', \widetilde{\widetilde{x}}', k + \pi^s) = 0$ decreases with $k + \pi^s$.Since $\widetilde{\widetilde{x}}(\widetilde{x})$ such that $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ is a decreasing function of $\widetilde{x}$, we have that if $(\widetilde{x}, \widetilde{\widetilde{x}})$ satisfy $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ and $h(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}, k + \pi^s) = 0$ and $(\widetilde{x}', \widetilde{\widetilde{x}}')$ satisfy $g(\widetilde{\widetilde{x}}', \widetilde{x}', \widetilde{\widetilde{x}}') = 0$ and $h(\widetilde{\widetilde{x}}', \widetilde{x}', \widetilde{\widetilde{x}}', k' + \pi^{s\prime}) = 0$ for $k' + \pi^{s\prime} < k + \pi^s$ then $\widetilde{x} > \widetilde{x}'$ and $\widetilde{\widetilde{x}} < \widetilde{\widetilde{x}}'$.

## Proof of Proposition 3

Following the same procedure as in Section 4, we are going to obtain $g(x_i, \widetilde{x}_j, \widetilde{\widetilde{x}}_j, y)$, $h(x_i, \widetilde{x}_j, \widetilde{\widetilde{x}}_j, y)$ and $m(x_i, \widetilde{x}_j, \widetilde{\widetilde{x}}_j, y)$. The same arguments of the proof of Lemma 3 apply here and we need again to look for intersections of $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}, y)$ and $h(\widetilde{x}, \widetilde{x}, \widetilde{\widetilde{x}}, y)$ when $\widetilde{\widetilde{x}} \leq \widetilde{x}$ and of $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}, y)$ and $m(\widetilde{x}, \widetilde{x}, \widetilde{\widetilde{x}}, y)$ when $\widetilde{\widetilde{x}} \geq \widetilde{x}$. Except for the proof of $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}, y)$ being an increasing function of $\widetilde{\widetilde{x}}$, all the other derivatives in the proof of Proposition 1 are exactly the same. The same arguments will, therefore, apply if we show that $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}, y)$ is increasing in $\widetilde{\widetilde{x}}$.

Now instead of two, we have six different orderings of $(\widetilde{x}, \widetilde{\widetilde{x}}, y)$. Substituting $E()$ and $\Pr ob()$ for the first case, in which $\widetilde{x} \geq \widetilde{\widetilde{x}} \geq y$, we have that $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}, y) = \widetilde{x} - \frac{3d}{d-1} + (2y+l)$ and $\widetilde{\widetilde{x}}$ in function of $\widetilde{x}$ such that $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}, y) = 0$ would not be well defined. We need thus that neither this case nor the case where $\widetilde{\widetilde{x}} \geq \widetilde{x} \geq y$, appears. This occurs if $l \geq l' \equiv 3(\frac{d}{d-1} - y)$. If we substitute for the case in which $\widetilde{x} \geq y \geq \widetilde{\widetilde{x}}$ we have that $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}, y) = \widetilde{\widetilde{x}} - \frac{3d-(d-1)(l+\widetilde{x})}{2(d-1)}$ and this is clearly increasing in $\widetilde{\widetilde{x}}$. If we substitute for the case in which $y \geq \widetilde{x} \geq \widetilde{\widetilde{x}}$ we then have that $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}, y) = \frac{(y+\widetilde{\widetilde{x}})(y-\widetilde{x})+(\widetilde{\widetilde{x}}+2l-y)\frac{(2\widetilde{\widetilde{x}}+l+y)}{3}}{2(y-\widetilde{x})+(\widetilde{\widetilde{x}}+2l-y)} - \frac{d}{d-1}$. This function is increasing in $\widetilde{\widetilde{x}}$. If we substitute for the case in which $y \geq \widetilde{\widetilde{x}} \geq \widetilde{x}$ we then have that $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}, y) = \frac{3(\widetilde{\widetilde{x}}-y+2l)(\widetilde{\widetilde{x}}+y)2l-(\widetilde{x}-y+2l)^2(\widetilde{x}+2y-l)}{12l(\widetilde{\widetilde{x}}+2l-y)-3(\widetilde{x}-y+2l)^2}\left[1+(d-2)\frac{(y+2l-\widetilde{\widetilde{x}})(\widetilde{\widetilde{x}}+2l-y)}{4l(\widetilde{\widetilde{x}}+2l-y)-(\widetilde{x}-y+2l)^2}\right] - d$. Computations show that, in this case, $\lim_{l\to\infty} \frac{\partial g}{\partial \widetilde{\widetilde{x}}}(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}, y, l) = \infty$ and hence, there exists $l''$ such that if $l \geq l''$ then $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}, y, l)$ is increasing in $\widetilde{\widetilde{x}}$. Similarly, there exists $l'''$ such that if $l \geq l'''$ then $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}, y, l)$ is increasing in $\widetilde{\widetilde{x}}$ for the remaining case. Summarising, if $l \geq l^{**} \equiv \max\{l', l'', l'''\}$ then $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}, y)$ is an increasing function of $\widetilde{\widetilde{x}}$.

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